DOCUMENT RESUME

ED 128 575 CE 007 569

TITLE	Welding and Cutting. Trade and Industrial Education Trade Preparatory Training Guide.
INSTITUTION	Nebraska State Dept. of Education, Lincoln. Div. of Vocational Education.
PUB DATE	[73]
NOTE	92p.; For related documents see CE 007 553-568. Appendix A, Application for Employment, may not reproduce well because of small type
EDRS PRICE	MF-$0.83 HC-$4.67 Plus Postage.
DESCRIPTORS	Behavioral Objectives; Building Trades; Curriculum; *Curriculum Guides; *Job Skills; Metal Working Occupations; Occupational Information; Secondary Education; State Curriculum Guides; *Task Performance; *Trade and Industrial Education; Welders; *Welding
IDENTIFIERS	Nebraska

ABSTRACT

One of a series of curriculum guides prepared for the metals occupations cluster of the construction/fabrication occupational group, this guide identifies the essentials of the welding and cutting trade as recommended by successful welders. An instructional program based upon the implementation of the guide is expected to prepare a student to adequately perform entry level tasks required of a welder or to enter a post-secondary technical or apprenticeship program in welding where additional depth can be realized. Trade tasks or information are listed in chart form under such headings as safety, related information, general competencies, tools and equipment, cohesion, adhesion, adhesion processes, soldering processes, vertical and horizontal position welding, set up and operate equipment, and general operations and/or jobs. Space is provided on the charts to record for each item the date completed, teaching methods used, and teaching materials used. Also included are a list of teacher responsibilities, sources of occupational information, recommended tests and references, and a chart depicting the total construction/fabrication occupational curriculum. A typical application for employment and a sample trade and industrial education injury report are appended. (HD)

****
* Documents acquired by ERIC include many informal unpublished *
* materials not available from other sources. ERIC makes every effort *
* to obtain the best copy available. Nevertheless, items of marginal *
* reproducibility are often encountered and this affects the quality *
* of the microfiche and hardcopy reproductions ERIC makes available *
* via the ERIC Document Reproduction Service (EDRS). EDRS is not *
* responsible for the quality of the original document. Reproductions *
* supplied by EDRS are the best that can be made from the original. *
****

ED128575

TRADE AND INDUSTRIAL EDUCATION

TRADE PREPARATORY TRAINING GUIDE

WELDING AND CUTTING

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION
THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

NEBRASKA DEPARTMENT OF EDUCATION
Cecil E. Stanley, Commissioner
Glen H. Strain, Assistant Commissioner

Division of Vocational Education
233 South Tenth Street
Lincoln, Nebraska 68508

CE007589

CE 007 325

TABLE OF CONTENTS

Board Members. 2

Definitions Used In This Guide 3

Occupational Analysis Chart. 4

Introduction 5-6

Use Of This Guide. 7

Teacher Responsibilities*. 8-9

Welding and Cutting Content. 10-86

Appendix A 87-88

Appendix B 89

Recommended Texts and References 90

NEBRASKA STATE BOARD OF VOCATIONAL EDUCATION

Board Members

Gerald T. Whelan, Pres.
Frank E. Landis
R. Jerry Hargitt
Walter L. Moller
(Mrs.) Marilyn Fowler, Vice. Pres.
Willard H. Waldo
(Mrs.) Shirley A. Peterson
F. Y. Knapple

Nebraska Department of Education
Division of Vocational Education

Mr. Cecil E. Stanley
Commissioner of Education

Mr. Glen H. Strain
Assistant Commissioner
Vocational Education

Mr. Walter E. Erdkamp
Administrative Director
Trade and Industrial, Technical
and Health Occupations Education

Mr. Lloyd D. Mather, Consultant
Trade and Industrial Education

Mr. Elton B. Mendenhall, Director
Nebraska Research Coordinating Unit

Nebraska Technical Competency Project Staff
Center for Vocational and Technical Education
Kearney State College

Dr. L. Dean McClellan

Dr. James A. Miller

Graduate Assistants

Mr. Larry Kness

Mr. Michael Kenny

CONTRIBUTORS

Spahr Machine Company
Kearney, Nebraska

Dutron Welding & Repair
Ainsworth, Nebraska

Marlatt
Kearney, Nebraska

Mr. Lawrence Adams
Beatrice, Nebraska

Merle Mead
Kearney, Nebraska

RE. Mead Shop
Wood River, Nebraska

DEFINITIONS USED IN THIS GUIDE

Major Occupational Group

A grouping of similar and related occupational area clusters. These groups include occupations that have been determined to be the most relevant and pertinent for inclusion in vocational education in Nebraska.

Occupational Area Clusters

These clusters are distinguishable in terms of similar work performed, materials used, products produced, and/or services rendered. They include a wide variety of common occupational skills and knowledge.

Occupation

The career or employment engaged in by an individual for remuneration. This activity includes technical competencies and related technical information often referred to as one's vocation.

Technical Competency

The specific tasks required for a vocational trade and industrial graduate to perform successfully at the entry level in an occupational area. These technical competencies apply to the psychomotor domain and include elements which emphasize motor skills such as: operate a machine; measure; etc.

Related Technical Information

The information the entry level worker must know in order to make appropriate trade decisions which will allow him to adequately perform the tasks or technical competencies of his occupation. This information applies to the cognitive domain and includes elements which are intellectual outcomes such as: knowledge and understanding.

Related General Information

Information which is desirable and good for the tradesman to know but which is not necessary to do his work properly; information that is nice to know, such as the history and development of his trade.

Related Guidance Information

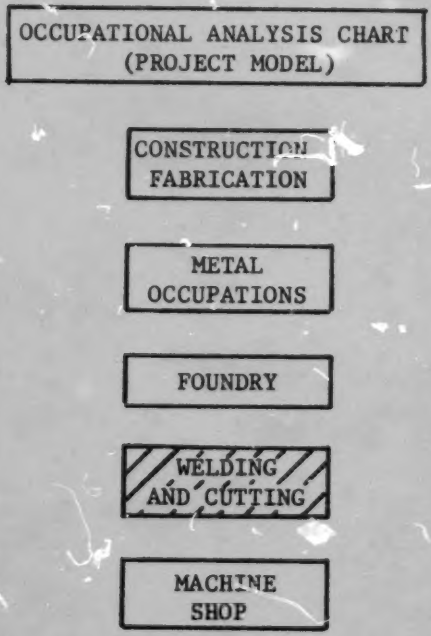
Information that helps the student choose, prepare for, secure, hold, and make progress in an occupation.

Entry Level

The technical competencies and related technical information deemed necessary by industry for obtaining and holding a job in a specific occupational area. This level of employment includes the technical competencies and related technical information that will be utilized by the employee within the first year of employment.

OCCUPATIONAL ANALYSIS CHART

The chart on this page shows Welding and Cutting as it relates to other occupations within the Metals Occupations cluster. Metal Occupations is one of two clusters which is a part of the major occupational group entitled Construction/Fabrication. This guide is concerned with Welding and Cutting only. Other guides have been prepared for each of the occupations found in this chart and are available through the Nebraska State Department of Education.



INTRODUCTION

This curriculum guide has been prepared with the help of competent craftsmen in the metal trades. The funds that made this guide a reality were provided through a federal research grant in cooperation with the Nebraska State Board of Vocational Education and sponsored by the Nebraska Research Coordinating Unit.

Curriculum guides have been prepared for several trade and industrial occupational clusters from which high school teachers can develop appropriate occupational related experiences for their students. The major occupational groups, occupational area clusters, and occupations are shown in graphic form on pages of this guide.

Selection of trades within four major occupational groups have been made based on a three year survey by the Nebraska Research Coordinating Unit on needs of Nebraska business and industry. This study has identified the occupations with the greatest need for employees. A related set of curriculum guides have been prepared for these occupations.

Guidance Information

The U.S. Department of Labor has developed an extremely helpful book entitled, "Occupational Outlook Handbook". This annual publication provides a very complete description of the activities of the persons employed in the occupations represented in the Nebraska trade and industrial curriculum guides. Information concerning current and future opportunities is a major portion of this publication. Inexpensive reprints in booklet form that describe individual occupations are available through the Department of Labor. These booklets should be used by trade and industrial teachers and school guidance counselors for the most up-to-date guidance information about a particular occupation.

A listing of these reprints from the "Occupational Outlook handbook," the order number, and price per copy is listed below for those occupations in the occupational area cluster of "Metal Occupations".

Number	Title	Price
1700-105	Machining Occupation - All-round Machinists, Machine Tool Operators, Tool and Die Makers, Instrument Maker, Setup Men	.15
1700-113	Welders, Oxygen and Arc Cutters	.10
1700-123	Foundries, Patternmakers, Molders Coremakers	.15

THE WELDING AND CUTTING GUIDE

This guide uses the title Welding and Cutting as the most logical descriptive term for identifying a particular related group of workers. Identification of specific job titles within this group should be determined by referring to the "Dictionary of Occupational Titles". The USOE classification system for coding instructional programs has assigned 810- and 819.887 to the instructional program, Welding and Cutting.

The information within this guide identifies the essentials of the welding and cutting trade as recommended by successful welders. An instructional program based upon the implementation of this guide will prepare a student to adequately perform entry level tasks required of a welder or to enter a post-secondary technical or apprenticeship program in welding where additional depth can be realized.

The tasks and/or competencies identified within these covers are those agreed upon by a jury of reputable Nebraska welders. A separate group of persons directly employed within this trade in Nebraska have further verified these tasks and/or competencies. Jury members, tradesmen, and educators who contributed toward the development of content for this guide are listed in the front.

Course offerings in trade and industrial education in Nebraska are to be organized within two period blocks of time each day, five days a week. Time is to be set aside for classroom instruction directly related to manipulative laboratory instruction. The remainder of the student's day is to be utilized for general education subjects.

USE OF THIS GUIDE

The use of curriculum guides for trade and industrial education in Nebraska secondary schools may vary greatly, depending upon the depth and breadth of each school district's vocational program. Large school districts, for example, may utilize one particular curriculum guide to develop a course in a trade area such as welding. A small school district may, on the other hand incorporate several curriculum guides to develop a course in the metal occupations cluster.

The manipulative content identified in this guide is deemed necessary for inclusion in a course that is designed to prepare entry level welders and cutters. While not all secondary school facilities in Nebraska are equipped to expose students to all of this content through hands-on experience, it is assumed that this content will through some media become related technical information. This will insure inclusion of all content and provide at least discussion level understanding.

This guide is written with the assumption and expectation that the related technical information necessary to perform technical competencies will be a integral part of instruction. Thus, occupational decisions that must be made by an entry level worker will be developed along with each related manipulative activity.

The welding instructor who uses this guide is responsible for including the identified related technical information as well as the identified manipulative tasks. He is also responsible for the identification of competencies pertaining to general and guidance information, even though this information is not specifically identified for him.

Definitions for various terms used in this guide are presented in the front.

TEACHER RESPONSIBILITIES*

1. Use the American Vocational Association National Safety Council's "National Standards School Shop Safety Inspection Check List" for shop safety inspections. (Available from American Vocational Association, 1510 "H" Street, N.W., Washington, D.C. 20005)

2. Use safety check list to assure safe factors exist.

3. Require students to report ALL accidents to instructor.

4. Keep complete records of ALL accidents on file.

5. Report ALL accidents to the school administrator.

6. Develop safety consciousness in the students through teacher example--always doing things in the safe way.

7. Give shop demonstrations stressing safe use of machines.

8. Give shop demonstrations stressing safe use of hand tools.

9. Provide instruction on what to do in case of an accident.

10. Develop information sheets dealing with the safe use of specific machines.

11. Give demonstrations on the proper use and care of personal protective devices.

*These responsibilities are necessary for inclusion in all trade and industry programs in the State of Nebraska.

12. Develop information sheets dealing with the general safety rules for the trade.

13. Enclose all gears, moving belts, and other power transmission devices with permanent guards.

14. Prohibit students from operating machines when instructor is not present.

15. Prohibit the removal of guards and safety devices, even for a brief period, without the approval of the instructor.

16. Prohibit more than one operator from using a machine at one time.

17. Determine personal liability factors and liability coverage afforded through your school.

18. Provide for the bulk storage of flammable materials.

19. Mark the location of fire-fighting equipment.

20. Post instructions and inform students of building evacuation procedures.

21. Require the wearing of appropriate eye protection as specified by the State of Nebraska eye safety regulations.

22. Keep tools sharp, clean and in good working condition.

23. All shop personnel should be thoroughly familiar with the location of fire extinguishers and the type fire for which each extinguisher is designed.

WELDING AND CUTTING
(Identified Trade Tasks or Information)

TRADE TASK OR INFORMATION	DATE COMPLETED	TEACHING METHODS USED	TEACHING MATERIALS USED
Gas Welding			
SAFETY			
Identify lubricants which should never be used to lubricate oxyacetylene equipment.			
Describe the procedure and list the materials which can be used to test for leaks in an oxyacetylene system.			
Discuss uses of fire brick and asbestos in welding station and elaborate upon reasons for selecting these materials.			

TRADE TASK OR INFORMATION	DATE COMPLETED	TEACHING METHODS USED	TEACHING MATERIALS USED
Discuss safety practices which are unique to adhesion processes.			
Describe and illustrate the construction of an oxygen cylinder valve and discuss its safety features.			
Describe the construction of an oxygen cylinder and discuss its safety features.			
Describe the construction of an acetylene cylinder and discuss its safety features.			
List precautions to be followed in handling fuel and oxygen cylinders.		14	

List the various common items needed as protective clothing in oxyacetylene welding.

State precautions to be followed in welding tanks and containers.

List procedures for checking for leaks in oxyacetylene welding systems.

Explain why a person should stand to one side of the oxygen regulators when opening the oxygen cylinder valve.

Explain why cylinders should be kept away from exposure to high temperature.

TRADE TASK OR INFORMATION	DATE COMPLETED	TEACHING METHODS USED	TEACHING MATERIALS USED
Explain why cylinder caps should always be screwed on all cylinders that are not in use. Particularly while they are being moved.			
Explain why acetylene pressure in excess of 24 PSIG is extremely dangerous.			
Give reasons why cylinders should be supported by some device so that they will not tip over.			
Describe the conditions and metals which produce metal fume hazards.			

TOOLS AND EQUIPMENT (GAS)

Use and maintain:

- oxygen cylinders
- acetylene cylinders
- welding blowpipe (torch)
- cutting blowpipe (torch)
- interchangeable heads or tips
- interchangeable nozzles
- oxygen regulators
- acetylene regulators
- hydraulic back-pressure valves

TRADE TASK OR INFORMATION	DATE COMPLETED	TEACHING METHODS USED	TEACHING MATERIALS USED
hose			
hose connectors			
clamps and ferrules			
goggles			
gloves			
lighters			
wrenches			
welding table			
files (course to fine)			
hammers			
cold chisels			

power grinder

air chisel

welding rods

flux

tongs

PREHEATING EQUIPMENT

Use and maintain:

forge annealing bins

welding outfit truck

oxygen and acetylene manifold

protective clothing

-17-

TRADE TASK OR INFORMATION	DATE COMPLETED	TEACHING METHODS USED	TEACHING MATERIALS USED
OPERATIONS AND/OR JOBS (GAS)			
Identify both the oxygen and acetylene hoses by color and fittings.			
Identify lubricants which can be used to lubricate oxyacetylene equipment.			
Explain the primary use of welding filler rod.			
List five common gas welding filler rod metals.			
List the range in size (diameters) of standard gas welding filler rods.			

List, discuss, and describe various designs of fixtures used to hold, align and position various shaped metal parts to be welded.

Identify both the oxygen and acetylene cylinders by color and valves.

List factors to be considered in selection of welding rod diameters.

Light and correctly adjust an equal pressure type torch to obtain a carburizing flame.

TRADE TASK OR INFORMATION	DATE COMPLETED	TEACHING METHODS USED	TEACHING MATERIALS USED
Light and correctly adjust an equal pressure type torch to obtain an oxidizing flame.			
Identify the proper position of the regulator adjusting screw before the cylinder valve is opened.			
Demonstrate the correct procedure for opening a high pressure oxygen cylinder valve.			
Adjust an oxygen regulator so that the low pressure oxygen gauge indicates the pressure corresponding to the size of the tip orifice.			

Adjust an acetylene regulator so that the low pressure acetylene gauge indicates the pressure corresponding to the size of the tip orifice.

Demonstrate the proper procedure for shutting off an equal pressure torch.

-21-

CORRELATION (MANIPULATIVE EXERCISES)

Demonstrate or illustrate the correct procedure for puddling.

Perform the correct procedure in completing a forehand outside rodless corner joint and/or a rodless flange weld.

TRADE TASK OR INFORMATION	DATE COMPLETED	TEACHING METHODS USED	TEACHING MATERIALS USED
Perform the correct procedure in completing a forehand butt weld. (with rod)			
Perform the correct procedure in completing a forehand lap weld. (with rod)			
Perform the correct procedure in completing a forehand inside corner and/or a tee weld (with rod).			
Demonstrate and explain the recommended torch and welding rod positions for welding in the flat position.			

Illustrate and explain the proper way to prepare sheet and plate for welding standard joints.

Perform the correct procedure in completing a backhand butt weld on 1/8" steel sheet.

Illustrate and describe the appearance of a "good weld" in reference to each of the basic joints welded in the flat position.

Complete satisfactorily a manipulative practical examination consisting of at least three of the common welding joints welded in the flat position.

TRADE TASK OR INFORMATION	DATE COMPLETED	TEACHING METHODS USED	TEACHING MATERIALS USED
ADHESION (MANIPULATIVE EXERCISES)			
Perform a correct procedure in completing a:			
forehand butt braze weld			
forehand brazed butt weld			
forehand inside corner braze weld			
pipe to plate braze weld			

Illustrate and explain the proper way to prepare a cast iron plate for braze welding a butt joint.

Illustrate and explain the proper way to prepare a butt joint for brazing.

Complete satisfactorily a manipulative practical examination consisting of at least one braze welded joint and one brazed joint.

ADHESION PROCESSES

Brazing and Braze Welding

Define and identify the principles and results of the following:

block brazing

TRADE TASK OR INFORMATION	DATE COMPLETED	TEACHING METHODS USED	TEACHING MATERIALS USED
brazing			
braze welding			
capillary attraction			
flux			
hardsurfacing			
Explain the difference between brazing and soldering according to the definitions given by the American Welding Society.			
Explain the difference between brazing and braze welding according to the definitions given by the American Welding Society.			

List the advantages and disadvantages of adhesion processes as compared to cohesion processes in reference to effects upon base metal, strength, etc.

List at least six of the common brazing and braze welding filler metal alloys.

List and identify the two common compounds used in brazing and braze welding fluxes.

Explain the reasons for the need of close fits when joining pieces by the brazing process.

TRADE TASK OR INFORMATION	DATE COMPLETED	TEACHING METHODS USED	TEACHING MATERIALS USED
Explain and discuss the methods used to apply brazing and braze welding fluxes.			
List and discuss basic brazing and braze welding procedures commonly used in industry.			
Discuss uses and advantages of silver brazing.			
List the procedures, methods techniques, and materials which are unique to brazing and braze welding of aluminum.			
Discuss procedures used in brazing and braze welding cast and maleable iron.			

List the procedures for brazing with silver alloys.

SOLDERING PROCESS

Discuss reasons for using different solder alloys.

List and discuss common solder fluxes and their specific uses.

List and discuss operational procedures which must be performed in order to produce successful soldering.

Discuss the unique advantages and procedures involved in each of the following soldering techniques:

TRADE TASK OR INFORMATION	DATE COMPLETED	TEACHING METHODS USED	TEACHING MATERIAL USED
dip bath method			
stainless steel soldering			
die cast soldering			
soldering coper method			
torch soldering method			
VERTICAL AND HORIZONTAL POSITION WELDING (GAS)			
Perform the correct procedure in completing a forehand butt weld in the vertical position.		32	

Perform the correct procedure in completing an inside corner weld in the vertical position.

Perform the correct procedure in completing a lap weld in the vertical position.

Perform the correct procedure in completing a forehand butt weld in the horizontal position.

Perform the correct procedure in completing an inside corner weld in the horizontal position.

-31-

TRADE TASK OR INFORMATION	DATE COMPLETED	TEACHING METHODS USED	TEACHING MATERIALS USED
Perform the correct procedure in completing a lap weld in the horizontal position.			
Perform the correct procedure in completing a backhand butt weld in the horizontal and vertical position.			
Demonstrate and explain the recommended torch and welding rod positions for welding in the vertical and horizontal position.			

Illustrate and describe the appearance of a good weld in reference to each of the basic joints welded in the vertical and horizontal position, using both the forehand and backhand techniques.

Complete satisfactorily a manipulative practical examination consisting of at least one of the common welding joints welded in the vertical and horizontal positions.

RELATED INFORMATION (GAS)

Present knowledge and understanding of the principles of the equal pressure type welding torch

TRADE TASK OR INFORMATION	DATE COMPLETED	TEACHING METHODS USED	TEACHING MATERIALS USED
Explain the principle of oxygen as an aid to combustion and not a flamable gas.			
State the PSIG pressures for full cylinders of oxygen and acetylene at room temperature.			
Describe a typical acetylene generator and discuss its uses, advantages, and disadvantages.			
Distinguish the difference between a line station regulator and a master service regulator.			

Explain how each of the three oxyacetylene flame adjustments affect the welding puddle and base metal.

List the variables to be considered in the selection of various torch tip sizes.

List the steps involved in lighting an injector-type welding torch.

List reasons for purging valves, regulators, lines, and torches before assembly and use.

Describe the conditions which cause or result in a torch backfire.

TRADE TASK OR INFORMATION	DATE COMPLETED	TEACHING METHODS USED	TEACHING MATERIALS USED
Describe the conditions which cause or result in an oxyacetylene system flashback.			
Explain the basic concept and principles of the gas welding process.			
GENERAL COMPETENCIES (GAS)			
Demonstrate or illustrate the proper angle of the torch tip in relation to the base metal when welding in the flat position.			
List and describe the tools which can be used to keep torch tips in good operational condition.			

List the six basic items which make up a basic oxyacetylene welding outfit.

Arc Welding

SAFETY

Discuss and describe harmful effects of ultra-violet and infra-red rays on an individual.

List hazards to be avoided in arc welding.

Identify safety items of the welding operator and station before starting to weld.

TRADE TASK OR INFORMATION	DATE COMPLETED	TEACHING METHODS USED	TEACHING MATERIALS USED
Check all electrical connections on an inert gas-arc welding machine for correct location before turning the machine on.			
TOOLS AND EQUIPMENT (ARC)			
Use and maintain:			
transformers (ac current)			
helmet			
goggles			
gloves			
protective clothing and apron			

chipping hammers

insulated electrode holders

steel wire brush

power grinder

ventilation system

welding table

clamps

welding booth with canopy

cables and ground clamp

welding electrodes

cold chisels

TRADE TASK OR INFORMATION	DATE COMPLETED	TEACHING METHODS USED	TEACHING MATERIALS USED
air chisel			
vise			
tongs			
vise grips			
GENERAL OPERATIONS AND/ OR JOBS			
Explain the numbering system used by the AWS and ASTM in classification of electrodes.			
Explain the color code system used by AWS and ASTM for the classifications of electrodes.			

Explain AC and DC current by drawing the sine wave of each.

Select the correct polarity for deep penetration welding and list the reasons for the selection.

Draw and explain the primary and secondary on an AC welding machine.

Discuss the design and operation of a multi-tap welding machine.

Demonstrate and list the steps involved in preparing the welding machine for operation.

TRADE TASK OR INFORMATION	DATE COMPLETED	TEACHING METHODS USED	TEACHING MATERIALS USED
List the reasons why metal must be clean before welding.			
Select the correct amperages for welding mild steel of 1/8" to 3/8" thickness.			
Demonstrate the process of beveling the edge of metal 1/8" or over for butt welding.			
List and check all safety rules before starting to weld.			
Select the correct electrode and welding in all welding positions.			
Select the correct electrode for the metal to be welded.			

Weld with a steady speed creating even ripples on the weld.

Weld with the arc length approximately equal to the gauge of the electrode.

Demonstrate the starting of an arc by the scratch method.

Demonstrate the starting of an arc by the up-and-down method.

Demonstrate the ending of an arc by bringing the electrode back toward the pubble.

List two reasons for excessive splatter on a weld.

Identify a steady arc by the steady frying sound of the electrode.

TRADE TASK OR INFORMATION	DATE COMPLETED	TEACHING METHODS USED	TEACHING MATERIALS USED
Inspect the weld after cleaning for alignment, bead width, penetration, gas holes, spatter and an even bead.			
List the tools needed for cleaning the slag from the weld.			
Demonstrate the correct procedure for freeing an electrode stuck to the base metal.			
Demonstrate the correct procedure for restarting an arc in all positions.			
Chip and clean slag from the completed weld.			

Perform correctly the procedures in completing a butt joint, lap joint, "T" joint, corner joint, edge joint, in the flat position.

Demonstrate and list the steps in shutting down an arc welding machine.

Perform correctly the procedures in completing a multiple pass joint in the flat position.

Weld in the horizontal position.

Perform correctly the procedures in completing a lap joint, butt joint, multiple pass lap joint, in the horizontal position.

TRADE TASK OR INFORMATION	DATE COMPLETED	TEACHING METHODS USED	TEACHING MATERIALS USED
List and explain the reasons why vertical downward welding is recommended for thin gauge metal.			
Perform the correct procedures in welding with one of three weave patterns in the vertical upward position.			
Demonstrate the correct procedure for cooling the puddle in the upward vertical welding position.			
Perform correctly the procedures in completing a vertical lap joint, butt joint, "T" joint.			

Demonstrate the correct position of the electrode for overhead welding.

Perform correctly the procedures in completing a "T" joint, butt joint, and a lap joint in the overhead position.

-47-

List open circuit voltage for AC and DC welding.

List open circuit voltage for AC and DC welding.

List closed circuit voltage for AC and DC welding.

List four types of coating for electrodes.

TRADE TASK OR INFORMATION	DATE COMPLETED	TEACHING METHODS USED	TEACHING MATERIALS USED
Describe concepts involved in the operation of a generator DC type welding machine.			
List and discuss differences between arc and resistant welding.			
Sketch and identify the following symbols:			
back or backing weld symbol			
surfacing weld symbol indicating built-up surface			
double-fillet weld			

chain-intermittent-fillet weld

staggered intermittent-fillet weld

single-V groove weld

SETUP AND OPERATE EQUIPMENT (TIG)

-49-

Describe the purpose of inert gas in TIG welding.

Describe the AC and DC current flow in a TIG torch.

Identify and describe the holding mechanism for a tungsten in a TIG torch.

TRADE TASK OR INFORMATION	DATE COMPLETED	TEACHING METHODS USED	TEACHING MATERIALS USED
List and identify the items needed to set-up a complete water cooled TIG welding station.			
Shape the end of the tungsten electrode to a point for DCSP TIG welding.			
Shape the end of the tungsten electrode to a sphere for AC TIG welding.			
Identify and discuss the differences between a clean tungsten electrode and a contaminated tungsten electrode.			
List and discuss the cleaning action of the arc in AC and DCRP TIG welding.			

WELDING OPERATIONS (TIG)

Perform the correct procedure for adjusting the TIG welding machine for the proper polarity according to the metal to be welded.

Perform the correct procedure for adjusting the TIG welding machine for proper amperage according to the metal to be welded.

Select and connect the proper electrode cup on a TIG welding machine according to the metal to be welded.

TRADE TASK OR INFORMATION	DATE COMPLETED	TEACHING METHODS USED	TEACHING MATERIALS USED
Select and insert the proper tungsten electrode in a TIG torch according to the metal to be welded.			
Adjust the flow meter on a TIG welder to the correct flow according to the metal to be welded.			
Demonstrate the procedure for starting and controlling a molten pool of metal in TIG welding.			
Demonstrate the procedure for welding with a TIG welding machine an even ripple as in oxy-act welding.			

Perform the correct procedure for breaking an arc and controlling the gas shield in TIG welding.

Perform the correct procedure for welding aluminum in the flat position in TIG welding.

Perform the correct procedure for welding stainless steel in the flat position in TIG welding.

Perform the correct procedures for welding mild steel in the flat position in TIG welding.

TRADE TASK OR INFORMATION	DATE COMPLETED	TEACHING METHODS USED	TEACHING MATERIALS USED
SET UP AND OPERATE EQUIPMENT (MIG)			
List and discuss three kinds of arc welding that can be done on a MIG welding machine.			
List and discuss the operation involved in setting up the motor and wire spool for a MIG welding machine.			
Identify and discuss the procedure for welding by the spray arc method.			
Identify and discuss the procedure for welding by the short circuiting method (drip transfer).			

List and describe the equipment needed for a complete gas metal-arc welding station.

Identify the procedures for setting up a gas metal-arc welding station.

List and discuss the steps in gas metal pulse arc welding.

Identify and discuss the three methods that flux may be used in the gas metal-arc welding.

Discuss and explain the characteristics of consumable electrode wire for inert gas welding.

TRADE TASK OR INFORMATION	DATE COMPLETED	TEACHING METHODS USED	TEACHING MATERIALS USED
WELDING OPERATIONS (MIG)			
Demonstrate the steps needed to be checked by the welding operator before welding begins.			
Select the correct amperage to be used for welding with a MIG welder according to the metal to be welded.			
Select the correct electrode speed according to the metal to be welded in MIG welding.			
Select the correct inert gas flow according to the metal to be welded in MIG welding.			

Perform correctly the procedures for welding mild steel in all positions with a MIG welding machine.

GENERAL INFORMATION
(MIG AND TIG)

List three inert gases used in gas-arc welding.

List and explain the advantages of inert gas-arc welding over arc welding.

List and explain the three types of current flow used in inert gas-arc welding.

List and discuss the characteristics of helium as it pertains to use in inert gas welding.

TRADE TASK OR INFORMATION	DATE COMPLETED	TEACHING METHODS USED	TEACHING MATERIALS USED
List and discuss the characteristics of argon as it applies to use in inert gas welding.			
List and discuss the characteristics of carbon dioxide as it applies to use in inert gas welding.			
List and discuss the advantages of mixing two or more gases together for use in shielded gas-arc welding.			
List and identify the component parts of a complete inert gas outfit for shielded arc welding.			

Know the advantages of the four types of power supplies for inert gas-arc welding.

List, discuss and demonstrate the correct maintenance of metalic arc welding equipment.

Sketch and explain the operations of a flow meter.

TOOLS AND EQUIPMENT (TIG)

Use and maintain:

an AC arc welding machine (with high frequency generator)

DC arc welding machine

TRADE TASK OR INFORMATION	DATE COMPLETED	TEACHING METHODS USED	TEACHING MATERIALS USED
TIG welding machine			
electrode holder (torch)			
gas cups			
shielding gas supply (inert)			
protective equipment (apron, gloves, goggles)			
filler rod			
pressure reducing regulator			
flow meter			

supply of cooling water

gas nozzles

gas regulators

filler wire feed mechanism

hand shield

helmet

accessories: clamps, welding table, vise, vise grips, and pliers

TRADE TASK OR INFORMATION	DATE COMPLETED	TEACHING METHODS USED	TEACHING MATERIALS USED
TOOLS AND EQUIPMENT (MIG)			
Use and maintain:			
rectifier (DC current)			
motor generator (DC current)			
wire feeding mechanism (automatic)			
welding gun			
shielding gas			
protective clothing			
clamps			
welding table			

vise

vise grips

pliers

Flame Cutting

SAFETY

List all of the equipment needed to set up a basic manual oxygen cutting station.

List and demonstrate the steps involved in set-up and operation of a basic equal pressure oxy-acetlene cutting torch.

TRADE TASK OR INFORMATION	DATE COMPLETED	TEACHING METHODS USED	TEACHING MATERIALS USED
Adjust the oxygen and acetylene regulators properly according to the tip size of the cutting torch.			
Adjust the oxyacetylene cutting torch flame to cut steel.			
Explain the concept and principles of oxyacetylene cutting.			
Define terms as given by the American Welding Society and demonstrate knowledge of an ability to correctly apply or identify the principles and/or results of each.			

List the six variables to be considered when oxyacetylene cutting.

List and discuss the advantages of automatic cutting operations used in industry.

Sketch five of the most common cutting torch tips and explain their unique advantages and uses.

List some of the torch guides (example: straight edge) available for manual oxyacetylene cutting.

Identify hazards which are present due to sparking and flying of sparks and molten globules of metal produced by the oxyacetylene cutting process.

TRADE TASK OR INFORMATION	DATE COMPLETED	TEACHING METHODS USED	TEACHING MATERIALS USED
State precautions in cutting tanks and containers.			
List fire protection equipment which should be available at all times in the oxyacetylene cutting area.			
Identify and list special safety clothing and equipment which should be available to protect the operator from molten spatter.			
Identify certain metals which should never be cut with the oxyacetylene cutting process. (example: magnesium)			

Discuss the differences between carbon steel and alloy steel.

List the percentage of carbon content from .003 (wrought iron) through the range of low carbon steel, medium carbon steel, high carbon steel, very high carbon steel, and cast iron, according to the iron-carbon equilibrium diagram.

Interpret, explain, demonstrate a working knowledge of the iron-carbon equalibrium diagram. Relate this knowledge to what happens to carbon steels during the welding process.

TRADE TASK OR INFORMATION	DATE COMPLETED	TEACHING METHODS USED	TEACHING MATERIALS USED
Interpret the SAE-AISI carbon steel composition numbers chart.			
Explain the concept of how carbon content varies depending on the use of the steel. (Example: axles-40 point carbon, cold chisels-80 point carbon, nails-10 point carbon, etc.). Relate this concept to terms such as ductility, harden ability, etc.			
HEAT TREATMENT OF METALS			
Explain what welding does to the heat treatment of metal and discuss the effect it has upon the physical properties.			

List and explain the purposes of heat treatment.

List and discuss the <u>three</u> following factors which are of great importance when heat treating:

the temperature to which the metal is heated

the length of time that the metal is held at that temperature and the speed of cooling time. (time factor)

the materials surrounding the metal when it is heated.

TRADE TASK OR INFORMATION	DATE COMPLETED	TEACHING METHODS USED	TEACHING MATERIALS USED
Explain the term "temperature gradient" and illustrate.			
List and explain methods used in heating metal during heat treating processes.			
List and explain methods used in cooling metals during heat treating processes.			
List and discuss advantages and disadvantages of cooling mediums used in hardening.			
Define and discuss the following heat treating processes:			

flame hardening

casehardening

induction hardening

nitriding

Explain, discuss, and perform standard heat treating processes upon the following metals:

carbon steels

alloy steels

cast iron

Set-up, operate, and properly adjust a gas forge or furnace.

TRADE TASK OR INFORMATION	DATE COMPLETED	TEACHING METHODS USED	TEACHING MATERIALS USED
Explain the term "temperature gradient" and illustrate.			
List and explain methods used in heating metal during heat treating processes.			
List and explain methods used in cooling metals during heat treating processes.			
List and discuss advantages and disadvantages of cooling mediums used in hardening steels.			
Define and discuss the following heat treating processes:			

flame hardening

casehardening

induction hardening

nitriding

Explain, discuss, and perform standard heat treating processes upon the following metals:

carbon steels

alloy steels

cast iron

Set-up, operate, and properly adjust a gas forge or furnace.

TRADE TASK OR INFORMATION	DATE COMPLETED	TEACHING METHODS USED	TEACHING MATERIALS USED
Set-up and operate an electric heat treat furnace.			
Define and demonstrate a working knowledge of the following physical properties of metals:			
tensil strength			
ductility			
hardness			
brittleness			
compression strength			

elongation

malloability

toughness

grain size

Define and demonstrate a working knowledge of the following types of stresses or loads imposed on metal structures:

compression

tension

shear

torsion

bending (flexure)

TRADE TASK OR INFORMATION	DATE COMPLETED	TEACHING METHODS USED	TEACHING MATERIALS USED
fatique (vibration)			
Discuss the phenomenon which occurs whenever an "alloying metal" is added to a "pure metal". This change will be illustrated by constructing and explaining a cooling curve for a simple alloy. (example: lead-tin diagram)			
Determine the nature of common metals used in industry by demonstrating a working knowledge of the following common metal tests:			

spark test

oxyacetylene torch test

fracture test

color test

density or specific gravity test

ring or sound or metal upon impacting with some other metal

magnetic test

chemical test

chip test

penetrant dye test

TRADE TASK OR INFORMATION	DATE COMPLETED	TEACHING METHODS USED	TEACHING MATERIALS USED
Identify nonferrous metals by the following tests:			
color test			
spark test			
magnetic test			
Identify by sight, the following forms of cast iron:			
gray			
white			
nodular (ductile iron)			

The student will also be able to explain the procedures used to obtain these differences.

List and discuss, and perform some of the following nondestructive methods used to determine the quality of a weld:

- nondestructive tests

  visual inspection

  magnetic particle inspections

  liquid

  ultrasonic inspection

TRADE TASK OR INFORMATION	DATE COMPLETED	TEACHING METHODS USED	TEACHING MATERIALS USED
X-ray inspection			
edy current inspection			
mass spectrometer detection			
air pressure leak tests			
halogen gas leak tests			
destructive tests			
tensil test			
bend test			
microscopic test			

hardness test

hydrostatic test to destruction

List and discuss the following items to be determined in laboratory tests of metals and welds:

tensil strength

ductility

hardness

microstructure

macrostructure

chemical constituents

TRADE TASK OR INFORMATION	DATE COMPLETED	TEACHING METHODS USED	TEACHING MATERIALS USED
Interpret a table showing comparisons of hardness numbers in Rockwell, Brinell, and Schleroscope scales.			
Set-up, operate, and interpret the readings on a hydraulic tensil tester.			
Detect surface flaws in metals by using liquid penetrant dyes or fluorescent penetrant method of inspection.			

Define, discuss, and graphically present information concerning the following terms as they directly relate to one another:

tensil strength of metal

yield point of metal

ductility of metal

Define and demonstrate knowledge of and ability to correctly apply or identify the principles and/or results of:

cooling curve

iron-carbon diagram

TRADE TASK OR INFORMATION	DATE COMPLETED	TEACHING METHODS USED	TEACHING MATERIALS USED
physical properties			
weldability and machinability			
phosphorus and sulfur			
castiron (white) and cast iron (gray)			
iron carbide			
electric furnace			
alloy			
nonferrous metals			
ferrous metals			

List the primary elements present in each of the following alloys:

carbon steel

brass

bronze

alloy steels

stellite

solder

Discuss the effects of phosphorus and sulphur in steels as they relate to weldability, machinability, etc.

TRADE TASK OR INFORMATION	DATE COMPLETED	TEACHING METHODS USED	TEACHING MATERIALS USED
Define the following terms as they relate to steels and elaborate upon the processes and/or procedures used to perform each:			
annealing			
hardening			
tempering (drawing)			
normalizing			

Appendix A

One of the primary objectives of trade and industrial education is the successful placement of students completing course work in a specific occupation. The following sample application form is included in this guide with the recommendation that the preparation of such forms become a necessary activity for students in all trade and industrial education courses.

APPLICATION FOR EMPLOYMENT

PERSONAL INFORMATION

DATE _____ SOCIAL SECURITY NUMBER _____

NAME _____ (LAST, FIRST, MIDDLE)

PRESENT ADDRESS _____ (STREET, CITY, STATE)

PERMANENT ADDRESS _____ (STREET, CITY, STATE)

PHONE NO. _____ OWN HOME _____ RENT _____ BOARD _____

DATE OF BIRTH _____ HEIGHT _____ WEIGHT _____ COLOR OF HAIR _____ COLOR OF EYES _____

MARRIED _____ SINGLE _____ WIDOWED _____ DIVORCED _____ SEPARATED _____

NUMBER OF CHILDREN _____ DEPENDENTS OTHER THAN WIFE OR CHILDREN _____ CITIZEN OF U. S. A. YES ○ NO ○

IF RELATED TO ANYONE IN OUR EMPLOY, STATE NAME AND DEPARTMENT _____ REFERRED BY _____

EMPLOYMENT DESIRED

POSITION _____ DATE YOU CAN START _____ SALARY DESIRED _____

ARE YOU EMPLOYED NOW? _____ IF SO MAY WE INQUIRE OF YOUR PRESENT EMPLOYER _____

EVER APPLIED TO THIS COMPANY BEFORE? _____ WHERE _____ WHEN _____

EDUCATION	NAME and LOCATION OF SCHOOL	YEARS ATTENDED	DATE GRADUATED	SUBJECTS STUDIED
GRAMMAR SCHOOL				
HIGH SCHOOL				
COLLEGE				
TRADE, BUSINESS OR CORRESPONDENCE SCHOOL				

SUBJECTS OF SPECIAL STUDY OR RESEARCH WORK _____

WHAT FOREIGN LANGUAGES DO YOU SPEAK FLUENTLY? _____ READ _____ WRITE _____

U. S. MILITARY OR NAVAL SERVICE _____ RANK _____ PRESENT MEMBERSHIP IN NATIONAL GUARD OR RESERVES _____

(CONTINUED ON OTHER SIDE)

FORMER EMPLOYERS (LIST BELOW LAST FOUR EMPLOYERS, STARTING WITH LAST ONE FIRST.)

DATE MONTH AND YEAR	NAME AND ADDRESS OF EMPLOYER	SALARY	POSITION	REASON FOR LEAVING
FROM				
TO				
FROM				
TO				
FROM				
TO				
FROM				
TO				

REFERENCES: GIVE BELOW THE NAMES OF THREE PERSONS NOT RELATED TO YOU, WHOM YOU HAVE KNOWN AT LEAST ONE YEAR.

	NAME	ADDRESS	BUSINESS	YEARS ACQUAINTED
1				
2				
3				

PHYSICAL RECORD:

LIST ANY PHYSICAL DEFECTS

WERE YOU EVER INJURED? GIVE DETAILS

HAVE YOU ANY DEFECTS IN HEARING? IN VISION? IN SPEECH?

IN CASE OF EMERGENCY NOTIFY

NAME ADDRESS PHONE NO.

I AUTHORIZE INVESTIGATION OF ALL STATEMENTS CONTAINED IN THIS APPLICATION. I UNDERSTAND THAT MISREPRESENTATION OR OMISSION OF FACTS CALLED FOR IS CAUSE FOR DISMISSAL. FURTHER, I UNDERSTAND AND AGREE THAT MY EMPLOYMENT IS FOR NO DEFINITE PERIOD AND MAY, REGARDLESS OF THE DATE OF PAYMENT OF MY WAGES AND SALARY BE TERMINATED AT ANY TIME WITHOUT ANY PREVIOUS NOTICE.

DATE SIGNATURE

DO NOT WRITE BELOW THIS LINE

INTERVIEWED BY DATE

REMARKS:

NEATNESS		CHARACTER	
PERSONALITY		ABILITY	

HIRED FOR DEPT. POSITION WILL REPORT SALARY WAGES

APPROVED: 1. 2. 3.

EMPLOYMENT MANAGER DEPT. HEAD GENERAL MANAGER

Appendix B

One of the most important parts of any trade and industrial education course is a safety program. The following form is recommended for use in courses of this type.

SAMPLE
TRADE AND INDUSTRIAL EDUCATION
INJURY REPORT* **

Student injured _____ Date _____

Shop in which accident occurred _____ Time _____

Instructor in charge _____

Nature of injury _____

_____

First aid administered _____

_____ By whom? _____

Cause of injury _____

_____

Could injury have been prevented? ____ How? _____

_____

Action taken or recommendations made to prevent recurrence _____

Remarks: _____

_____

_____

Signed _____
(Person making report)

Witnesses: _____

Names _____
and
Addresses _____

*Complete in Duplicate
**File one copy in office

378.007 S25

RECOMMENDED TEXTS AND REFERENCES
Welding and Cutting
Bibliography

Glachino, J.W., Weeks, William, Brune, Elmer Welding Skills and Practices. Chicago: American Technical Society, 1967.

Linde Division The Oxy-Acetylene Handbook. New York: Union Carbide Corporation, 1960.

University of Missouri Welding Skills and Technology. Missouri: State Department of Education, 1972.

Sosnin, H.A. Arc Welding Instructions for the Beginners. Cleveland, Ohio: The Lincoln Electric Company.

Walker, John R. Modern Metalworking. Homewood, Illinois: The Good Heart-Willcox Company, 1965.

----- Basic Welding of Joints. Anaheim, California: Litton Instruction of Materials, Inc., 1966.

----- Current Welding Processes. New York: American Welding Society, 1968.

----- Procedure Handbook of Arc Welding Design and Practice. Cleveland, Ohio: The Lincoln Electric Company.

----- Simple Blueprint Reading. Cleveland, Ohio. The Lincoln Electric Company, 1940.

----- Welding, Cutting and Heating Guide. Denton, Texas: Victor, 1968.